

PCT

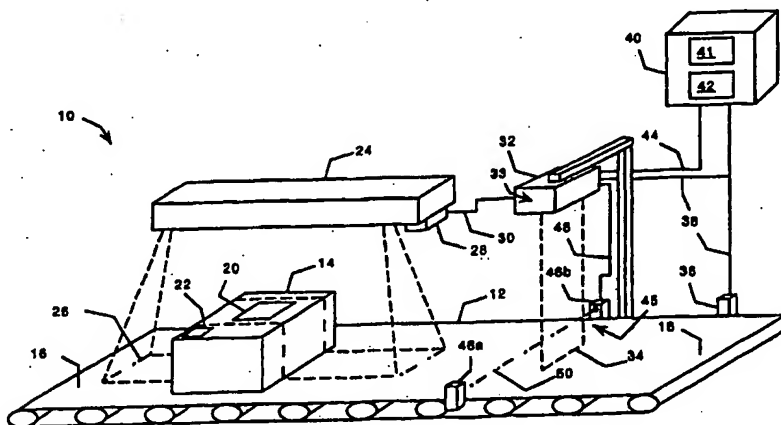
WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B07C 3/14		A1	(11) International Publication Number: WO 98/32545
			(43) International Publication Date: 30 July 1998 (30.07.98)
(21) International Application Number: PCT/US98/01366		(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(22) International Filing Date: 23 January 1998 (23.01.98)		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(30) Priority Data: 08/787,974 23 January 1997 (23.01.97) US 08/788,852 23 January 1997 (23.01.97) US			
(71) Applicant: UNITED PARCEL SERVICE OF AMERICA, INC. [US/US]; 55 Glenlake Parkway, N.E., Atlanta, GA 30328 (US).			
(72) Inventors: BONNET, Henri; 290 Crosstree Lane, Atlanta, GA 30328 (US). BJORNER, Johannes, A., S.; 7 Tamarack Lane, Woodbury, CT 06798 (US). PARDEE, Bennett; 60 Greenbush Road, P.O. Box 1070, Redding, CT 06875 (US). ALEXANDER, Catherine; 5 Round Hill Drive, Danbury, CT 06811 (US).			
(74) Agents: MEHRMAN, Michael, J. et al.; Jones & Askew, LLP, 37th floor, 191 Peachtree Street, N.E., Atlanta, GA 30303 (US).			

(54) Title: OPTICALLY-GUIDED INDICIA READER SYSTEM



(57) Abstract

An optically-guided indicia reader (10) system including a conveyor (12) carrying a parcel (14) bearing a destination address (20). An illumination source (24) defines an area (26) to assist the positioning of the parcel (14) on the conveyor (12). A scanner (32) and a computer memory (42) of a character recognition system (40) are operated so as to store an image of a region defined with respect to the moving illuminated area (26). A sensor assembly (28), including a height sensor and reflectivity sensor, is located toward the downstream location of the illumination source (24). The scanner (32) includes internal components (33) well known to those skilled in the art that automatically focuses the scanner in response to height data, and adjusts the gain of the scanner (32) in response to reflectivity data, so that the scanner (32) generates a clear image of the top of the parcel (14) as the parcel passes beneath the scanner (32). A photo sensor (45) is positioned upstream from the scanner (32) to detect the presence of the parcel (14). The video data generated by the scanner (32) may be stored in the computer memory (42) only when the beam (50) of the photo sensor (45) is broken. A time delay may be imposed to account for the distance between the beam (50) and the scan line (34). Alternatively, a moving-light illumination source (224) defines a spot (230) that moves at the same speed as the conveyor (212) to assist the positioning of the parcel (214) on the conveyor (212).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

5

10 **OPTICALLY-GUIDED INDICIA READER SYSTEM****Technical Field**

The present invention relates to image processing and more particularly relates to over-the-belt optical character recognition (OCR) systems. Specifically, the invention relates to an
15 indicia reader system that includes a projected optical guide to assist the positioning of parcels on a conveyor.

Background of the Invention

For years, machines have been used to scan parcels as they travel along a conveyor.
20 Over-the-belt optical character recognition (OCR) systems have been recently developed that can read indicia, such as a typed or hand-written destination address on parcels to be shipped. Parcel delivery companies, such as United Parcel Service, ship millions of parcels every day. These parcel delivery companies make extensive use of OCR systems to read the destination address labels on parcels to facilitate sorting and routing the parcels to their proper destinations.

25 The fundamental physical components of an OCR system are a scanner and a character recognition system including a central processing unit (CPU), a computer memory, and a sophisticated character recognition program module. The scanner is typically an optical camera, such as a charge-coupled device (CCD) array, that captures an image of the destination address on the parcels as they travel past the scanner on the conveyor. Generally, a continuous video
30 image of the conveyor carrying the parcels is captured by the scanner, which video image is converted into digital format and transmitted to the character recognition system. But only a small part of the video image, such as the portions including the destination addresses of the parcels, needs to be processed by the character recognition system. The OCR system, therefore, must have some way to identify the portions of the video image that need to be processed by the
35 character recognition system.

One approach is to store the entire video image created by the scanner, and later parse out the portions of the video image that need to be processed by the character recognition system. But a continuously running scanner generates an enormous amount of video data. This data is formatted as a continuous bit map of the conveyor as the conveyor carries parcels past the
40 scanner. This bit map inherently conveys information about the spatial relationship of the pixels of the image. Storing this continuous bit map requires an enormous amount of computer

memory. It is therefore advantageous to reduce the memory storage requirement.

Data compression is one technique for reducing the memory storage requirement. The video data may be compressed for storage using any of a variety of well known data compression methods, such as run length encoding. These data compression techniques, however, alter the bit-map format of the data. This is undesirable because it is advantageous for the character recognition program module to operate on bit maps that allow easy access to information regarding neighborhoods around individual pixels. The compressed data must therefore be uncompressed, typically into a frame buffer, for processing by the character recognition program module. Compressing the video data for storage, and then uncompressing the video data for processing, burdens the CPU and slows the character recognition process.

Real-time extraction of the desired portions of the video data is another technique for reducing the memory storage requirement. Indeed, real-time data extraction is a very effective technique because most of the video data created by the continuously running scanner is a useless image of the conveyor and the non-indicia bearing areas of the parcels moving along the conveyor; only a small percentage of the data includes the destination addresses of the parcels to be shipped. Therefore, extracting only small portions of the video data, such as relatively small areas covering the destination addresses, greatly reduces the memory storage requirement and speeds up the character recognition process.

Systems have been developed for triggering a video camera system so as to store only desired video images. For example, *Tonkin*, U.S. Patent No. 4,742,555, describes a mechanical limit switch, optical sensor, or magnetic sensor that triggers a video system to capture and store an image of a parcel as the parcel reaches a predetermined location along a conveyor. But the system described by *Tonkin* would have a significant drawback if applied to a parcel shipping system. This is because the system described by *Tonkin* captures an image of the entire parcel; is not operative for capturing only a specific portion of the image, such as the destination address. In a parcel shipping system, the destination address must be captured for sorting and routing purposes, but other indicia on the parcel, such as the return address, is not needed to route the parcel to its proper destination. It is therefore advantageous to identify the destination address prior to storing the image of the parcel, so that only the portion of the image containing the destination address may be stored in the computer memory.

Several difficulties are encountered, however, in attempting to identify the destination addresses on various parcels traveling on a conveyor. First, the destination addresses may vary in size, and may be in different locations on different parcels. Second, the parcels themselves may vary in size, shape, and position on the conveyor. Thus, the exact position of a destination address on a parcel cannot be determined by simply detecting the edge of the parcel using a limit switch or sensor, as described by *Tonkin*.

Systems have been developed for storing video images of selected portions of parcels traveling of a conveyor. For example, *Kizu et al.*, U.S. Patent No. 4,516,265, describes a two-camera system that reads the postal (zip) codes on envelopes traveling on an envelope transport

system. The system includes a low resolution prescanner that coarsely scans the surface of the envelope. The position of the destination address block is determined from the coarse scan, and the coordinates of the destination address block with respect to the leading edge of the envelope are then passed to a second, high-resolution camera system. The second camera system stores
5 an image of the destination address block by first detecting the leading edge of the envelope. The second camera system begins storing an image of the destination address block when the block reaches the second camera, and stops storing the image when the block moves past the second camera. A postal code reader subsequently processes the high-resolution scan to read the postal code.

10 Another example is disclosed in *Morton et al.*, U.S. Patent No. 5,642,442. This patent describes a two-camera system that reads the destination addresses on parcels traveling on a conveyor. A fluorescent ink fiduciary mark is superimposed relative to the destination address on a parcel. A first camera captures an image of the fiduciary mark, the position and orientation of which is ascertained. The position and orientation of the fiduciary mark is then used to extract
15 an image of the destination address from a video data signal created by a second camera, which is positioned downstream from the first camera. The image of the destination address is stored in a computer memory for subsequent processing by a character recognition system.

The two-camera systems described above are very effective at minimizing the amount of video data that must be stored in an OCR system. They are, however, rather expensive systems
20 that are best suited for very high-speed parcel handling systems. The cost associated with these systems may not be justified for many lower-speed parcel handling systems. There is, therefore, a need for a less expensive system for minimizing the amount of video data that must be stored in an OCR system. In particular, there is a need for an inexpensive indicia reader system that is suited to low- to medium-speed parcel handling systems.

25

Summary of the Invention

The invention seeks to provide a low-cost system for minimizing the amount of video data that must be stored in an OCR system. In particular, the invention seeks to provide an inexpensive indicia reader system suited to low- to medium-speed parcel handling systems.

30 In accordance with the invention, these objects are accomplished in an indicia reader system that includes an optical guide to assist the positioning of parcels on a conveyor. For example, the optical guide may include a static elongated strip of light projected toward the conveyor from an illumination source positioned above the conveyor. An operator positions a parcel on the conveyor so that indicia to be imaged, such as the destination address on the parcel,
35 is within static elongated strip of light. The parcel may also be positioned on the conveyor so that other indicia that is not to be imaged, such as the return address on the parcel, is not within the static elongated strip of light. Projecting the optical guide onto the parcel avoids parallax-related alignment errors that could otherwise occur with tall parcels in systems using other types of optical guides, such as reference marks placed on the conveyor itself.

The optically-guided indicia reader system may also include a proximity sensor, such as a photo detector, for detecting the arrival of the parcel at the scanner. In response to a signal from the proximity sensor, the computer memory and the scanner may be operated so as to store an image of a region having a width approximately equal to the width of the area defined by the illumination source, and a length approximately equal to the length of the parcel in the direction of conveyor travel.

The optically-guided indicia reader system may also include a reflectivity sensor located upstream of the scanner and positioned to determine reflectivity data associated with the parcel. A communication link transmits the reflectivity data from the reflectivity sensor to the scanner, and the gain of the scanner is adjusted in response to the reflectivity data. In addition, an optically-guided indicia reader system may include a height sensor located above the conveyor and upstream of the scanner and positioned to determine height data associated with the parcel at the location of the destination address. A communication link transmits the height data from the height sensor to the scanner, and the scanner is focused in response to the height data.

According to another aspect of the invention, an operator positions a parcel on the conveyor so that indicia to be imaged, such as the destination address on the parcel, coincides with a moving spot light defined by an illumination source. A scanner located downstream of the illumination source captures an image of a region that is defined with respect to the spot defined by the illumination source. For example, the optical guide may include a moving light, such as a narrow-beam spot light, that is projected onto the conveyor, and that travels at the same speed as the conveyor. Positioning a parcel on the conveyor so that the spot light is located in the center of the city and state address lines of the destination address allows a scanner to efficiently capture an image of the destination address for processing by a character recognition reader.

The moving-light indicia reader system includes a conveyor for transporting a parcel from an upstream location of the conveyor to a downstream location of the conveyor. A moving-light system, which is preferably positioned above the conveyor, includes an illumination source for defining a spot that moves at the same speed as the conveyor to assist in positioning the parcel on the conveyor. A scanner, which is located downstream from the moving-light illumination source, and a processing module are operated so as to store an image of a region of the parcel defined with respect to the spot defined by the moving-light illumination source. For example, the illumination source may define a spot that is substantially smaller than the region to be imaged by the scanner of the indicia reader system. An operator may then position a parcel so that the spot defined by the moving-light illumination source is located approximately in the center of the city and state lines of the destination address on the parcel.

A moving-light indicia reader system may also include a reflectivity sensor located upstream of the scanner and positioned to determine reflectivity data associated with the parcel. Reflectivity data from the reflectivity sensor is obtained for the spot defined by the moving-light illumination source so that reflectivity data is collected regarding the parcel at the region to be

captured and stored for subsequent processing by a character recognition system. A communication link transmits this reflectivity data from the reflectivity sensor to the scanner, and the gain of the scanner is adjusted in response to the reflectivity data. In addition, a moving-light indicia reader system may include a height sensor located above and upstream of the scanner and positioned to determine height data associated with the parcel at the location of the destination address. Height data from the height sensor is obtained for the spot defined by the moving-light illumination source so that height data is collected regarding the parcel at the region to be captured and stored for subsequent processing by the character recognition system. A communication link transmits this height data from the height sensor to the scanner, and the scanner is focused in response to the height data.

According to yet another aspect of the invention, a multi-conveyor indicia reader system includes a plurality of moving-light indicia reader systems, wherein each moving-light indicia reader system includes an illumination source for defining a spot that moves at the same speed as its respective conveyor to assist in positioning parcels on the conveyor. The processing module and the scanner of each moving-light indicia reader system are operated so as to store an image of a region of the parcel defined with respect to the spot defined by the illumination source. In addition, the illumination sources are operated so as to time-division multiplex the storage of the images generated by the several moving-light indicia reader systems.

That the present invention improves over the drawbacks of the prior art and accomplishes the objects of the invention will become apparent from the following detailed description of the preferred embodiment and the appended drawings and claims.

Brief Description of the Drawings

FIG. 1 is a diagram of an optically-guided indicia reader system.

FIG. 2, including FIGS. 2A-2E, illustrates a moving-light indicia reader system.

FIG. 3 illustrates a parcel with the spot defined by the moving-light system located approximately in the center of the city and state address lines of the destination address.

FIG. 4 illustrates a multi-conveyor indicia reader system.

Detailed Description

FIG. 1 is a diagram of an optically-guided indicia reader system 10 that includes a conveyor 12 carrying a parcel 14 from an upstream location 16 to a downstream location 18 of the conveyor 12. The parcel 14 includes indicia to be read by the optically-guided indicia reader system 10, such as a destination address 20. The parcel 14 may include other indicia, such as the return address, that the indicia reader system 10 preferably avoids reading.

An illumination source 24 is positioned to define a static area 26 to assist in positioning the parcel 14 on the conveyor 12. The area 26 is static in that it does not travel along with the conveyor 12, but remains stationary with respect to an operator station that is located along side the conveyor 12. Thus, the conveyor 12 travels through the area 26, which is defined by light

projected by the illumination source 24.

The illumination source 24 may define the area 26 many different ways. For example, illumination source 24 may illuminate the interior of area 26, or the border of the area 26, or two spaced-apart parallel lines in the direction of conveyor travel, etc. The illumination source
5 24 is positioned a sufficient distance above the conveyor 12 so that the parcel 14 may be positioned on the conveyor 12 to pass beneath the illumination source 24. An operator may therefore view the area 26, which is defined by light projected by the illumination source 24, directly on the parcel 14 as the operator positions the parcel 14 on the conveyor 12. The area 26 thus provides an optical guide to assist the operator in positioning the parcel 14 on the
10 conveyor 12.

A sensor assembly 28, including a height sensor and reflectivity sensor, may be located toward the downstream end of the illumination source 24. A communication link 30 functionally connects the sensor assembly 28 to a scanner 32 that is located downstream from the sensor assembly 28. The scanner 32 is focused in response to height data from the height
15 sensor, and the gain of the scanner 32 is adjusted in response to reflectivity data from the reflectivity sensor, so that the scanner 32 generates a clear image of the top of the parcel 14 as the parcel passes beneath the scanner 32. The scanner 32 is preferably positioned so that the scan line 34 is oriented across a portion of the conveyor 12 that is aligned with the area 26 in the cross-machine direction.

A belt encoder 36 measures the displacement of the conveyor 12. A communication link
20 38 functionally connects the belt encoder 36 to the scanner 32 and to a character recognition system 40 that includes a processing unit 41 and a computer memory 42. Another communication link 44 functionally connects the character recognition system 40 to the scanner 32. The height data from the sensor assembly 28 indicates the presence of a parcel 14 on a
25 particular location of the conveyor 12. Thus, the height data and the signal from the belt encoder 36 may be used to determine when a parcel 14 is present at the scanner 32.

Alternatively, a proximity sensor, such as a photo sensor 45, may be positioned upstream from the scanner 32. A communication link 48 functionally connects the scanner 32
30 to the photo sensor 45. The photo sensor includes a light source 46a that projects a columnar beam of light 50 toward a photo detector 46b. The photo sensor 45 detects the presence of the parcel 14 as it passes by the photo sensor 45 because the parcel breaks the beam of light 50. Many other types of proximity sensors, such as a mechanical or a magnetic sensor, may equivalently be used to detect the location of the parcel 14 on the conveyor 12.

The belt encoder 36 is a standard belt-driven, opto-mechanical encoder that provides a
35 signal indicating the linear displacement of the conveyor 12. The CCD array of the scanner 32 is cycled in response to the signal from the belt encoder 26 to generate a series of analog images of the scan line 34 that are transmitted to an analog-to-digital converter within the scanner 32. The analog-to-digital converter of the scanner 32 uses a standard thresholding or similar process to convert the analog signal produced by the CCD array of the scanner 32 into an eight-bit digital

video signal that is transmitted via the communication link 44 to the character recognition system 40, which stores the video data in the computer memory 42 for subsequent processing.

The region to be stored in the computer memory 42 may include all or part of the scan line 34. This may be accomplished by only storing the output of all or only a portion of the cells of the scanner 32. The region to be stored in the computer memory 42 is preferably aligned with and has a length that is approximately equal to the width of the area 26 so that the region stored in the computer memory 42 corresponds to, but is downstream from, the area 26 defined by the illumination source 24. This assists an operator in orienting a parcel 14 so that the destination address 20 can be effectively scanned by the indicia reader system 10 as configured. Alternatively, the operator may determine that the parcel 14 cannot be oriented so that the destination address 20 can be effectively scanned by the indicia reader system 10 as configured. This may happen if the destination address 20 is larger than the region to be stored in the computer memory 42. In this case, the operator can divert the parcel 14 for hand sorting or imaging using a differently configured indicia reader system.

The scanner 32 may run continuously, so that region generated by the scanner 32 and stored in the computer memory 42 of the character recognition system 40 is a continuous strip having a width approximately equal to the width of the area 26 defined by the illumination source 24. The size of the region may be further reduced by using the height data from the sensor assembly 28 or the signal from the photo sensor 45 to trigger the storage of video data generated by the scanner 32. For example, the video data generated by the scanner 32 may be stored in the computer memory 42 only when the beam 50 of the photo sensor 45 is broken. A time delay may be imposed to account for the distance between the beam 50 or the sensor assembly 28 and the scan line 34. In this manner, an image of a strip of the top of the parcel 14 including the destination address 20 may be stored in the computer memory 42. That is, an image of a region of the parcel 14 having a width approximately equal to the width of the area 26 defined by the illumination source 24, and a length approximately equal to the length of the parcel 14 in the direction of conveyor travel, may be stored in the computer memory 42 of the character recognition system 40.

Triggering the storage of the image of the region in the computer memory 42 may be accomplished in several different ways. For example, the scanner 32 may be toggled on and off by the signal from the photo sensor 45 or the sensor assembly 28 (with an appropriate time delay). Or the scanner 32 may run continuously, and the signal from the photo sensor 45 or the sensor assembly 28 may be used to latch a control line to an input buffer of the character recognition system 40. Alternatively, the signal from the photo sensor 25 or the sensor assembly 28 may be used as an input to a software-based algorithm running on the processing unit 41, which triggers the storage of video data from the scanner 32 in the computer memory 42. Many other means known to those skilled in the art may equivalently be employed to operate the computer memory 42 and the scanner 32 so as to store an image of a region in the computer memory 42.

To use the static-light indicia reader system 10, an operator positions the parcel 14 on the conveyor 12 so that the destination address 20 is within the area 26 defined by the illumination source 24. The operator may also position the parcel 14 on the conveyor 12 so that other indicia on the parcel 14, such as the return address 22, is not within the area 26 defined by the illumination source 24. It will be appreciated that many other types of indicia may be placed within, or excluded from, the area 26, such a barcode, a two-dimensional code, a hologram, etc.

Acceptable performance is experienced when optically-light indicia reader system 10 is configured as follows. The area 26 is typically a rectangular strip that is significantly narrower than the conveyor 12, sufficiently long to allow an operator to easily position a parcel on the conveyor 12 using the optical guide, and approximately in the center of the conveyor 12. For example, the area 26 may be approximately 4 inches (10 cm) in the cross-machine direction and approximately 12 (30 cm) to 36 inches (91 cm) in the direction of conveyor travel. The use of projected illumination, rather than an area painted on the conveyor 12, allows the operator to view the area 26 defined by the illumination source 24 directly on the top of the parcel 14. Thus, there is no displacement between the area 26 and the top of the parcel 14 that could cause parallax-related alignment errors with tall parcels. The use of a relatively narrow area 26 allows the angle of the field of view of the scanner 32 to be relatively narrow so that the scanner 32 generates a sharp image of the top of the parcel 14.

The belt encoder 36 is a standard belt-driven, opto-mechanical encoder that provides a signal indicating the linear displacement of the conveyor 12. The CCD array of the scanner 32 is cycled in response to the signal from the belt encoder 36 to generate a series of analog images of the scan line 34 that are transmitted to an analog-to-digital converter within the scanner 32. The analog-to-digital converter of the scanner 32 uses a standard thresholding or similar process to convert the analog signal produced by the CCD array of the scanner 32 into an eight-bit digital video signal that is transmitted via the communication link 44 to the character recognition system 40, which is operable for storing the video data in the computer memory 42 for subsequent processing.

The scanner 32 is preferably a monochrome, 4,096 pixel line-scan type CCD array such as one using a Thompson TH7833A CCD chip. As the field of view of the scanner 32 is approximately 16 inches (41 cm) at the conveyor 12, the resolution of the image created by the scanner 32 is approximately 256 pixels or "dots" per inch (DPI) (101 dots per cm) across the field of view of the scanner 32. The belt encoder 36 preferably triggers the CCD array of the scanner 32 at a rate of approximately 256 cycles per inch (101 cycles per cm) so that the resolution of the image created by the scanner 32 is approximately 256 pixels or "dots" per inch (DPI) (101 dots per cm) in the direction of conveyor travel. It will therefore be appreciated that a digital image with a correct aspect ratio (i.e., the ratio of the length of the image to the width) may be generated by the scanner 32 and stored in the computer memory 42 of the character recognition system 40 by synchronizing the cycling rate of the scanner 32 with the linear speed

of the conveyor 12. See, for example, *Shah et al.*, U.S. Patent No. 5,291,564, which is incorporated by reference.

The conveyor 12 may be approximately 24 inches (61 cm) wide and travel at linear speeds up to 20 inches per second or 100 feet per minute (51 cm per second or 30 meters per minute) or more. The illumination source 24, which may be any of a variety of commercially-
5 available narrow-beam light sources, is preferably positioned approximately 18 inches (46 cm) above conveyor 12 and defines an area 26 that is approximately 4 inches (10 cm) in the cross-machine direction and approximately 12 (30 cm) to 36 inches (91 cm) in the direction of conveyor travel.

The scanner 32 is preferably mounted to have an optical path of approximately 120 inches (304 cm) to the conveyor 12 with a 16 inch (41 cm) field of view at the conveyor 12. To save space, the scanner 32 is positioned approximately 30 inches (76 cm) above the center of conveyor 12 and is pointed towards a complex of mirrors (not shown) that increases the optical path from the scanner 32 to the conveyor 12 to approximately 120 inches (305 cm). These
10 parameters may be varied somewhat without unduly affecting the performance of the disclosed embodiment of the present invention. See also, *Smith et al.*, U.S. Patent No. 5,308,960, and *Bjorner, et al.*, U.S. Patent No. 5,485,263, which are incorporated by reference.

It should also be understood that the scan line 34 may be longer than the width of the region stored in the computer memory 42. For example, the scanner 32 may be positioned to
20 have a field of view (i.e. the scan line 34) equal to approximately 16 inches (41 cm) at the conveyor 12. The region stored in the computer memory 42, however, may only be approximately 4 inches (10 cm), which preferably corresponds to the width of the area 26 defined by the illumination source 24. This may be accomplished by only storing the output of a portion of the cells of the scanner 32 (e.g., the center 1,024 pixels of a 4,096 pixel scanner) in
25 the computer memory 42.

In view of the foregoing, it will be appreciated that the optically-guided indicia reader system 10 reduces the amount of video data that must be stored in the computer memory 42 of the character recognition system 40. The use of projected illumination allows the operator to view the area 30 defined by the illumination source 24 directly on the top of the parcel 14.
30 Thus, there is no displacement between the area 26 and the top of the parcel 14 that could cause parallax-related alignment errors with tall parcels. In addition, the optically-guided indicia reader system 10 allows the angle of the field of view of the scanner 32 to be relatively narrow so that the scanner 32 generates a sharp image of the top of the parcel 14.

FIGS. 2A-2E illustrate another embodiment of the invention, a single-conveyor moving-
35 light indicia reader system in which a moving-light illumination source defines a spot that moves at the same speed as a conveyor to assist the positioning of a parcel on the conveyor. FIG. 3 illustrates a parcel in this moving-light indicia reader system with the spot defined by the moving-light illumination source located approximately in the center of the region to be captured. More specifically, the parcel is preferably positioned on the conveyor so that the center of the

spot defined by the moving-light illumination source is approximately in the center of the city and state lines of the destination address. FIG. 4 illustrates a multi-conveyor indicia reader system, in which the illumination sources of a plurality of moving-light indicia reader systems are operated so as to time-division multiplex the storage of the images generated by the several moving-light indicia reader systems. These embodiments of the invention are described below.

FIGS. 2A-E illustrate a moving-light indicia reader system 200 including a conveyor 212 carrying a parcel 214 from an upstream location 216 to a downstream location 218 of the conveyor 212. The parcel 214 includes indicia to be read by the moving-light indicia reader system 200, such as a destination address 220. The parcel 214 may include other indicia, such as the return address, that the moving-light indicia reader system 200 preferably avoids reading.

The moving-light indicia reader system 200 includes a moving-light illumination source 224 that includes a plurality of discrete illumination sources 226a through 226n, such as light-emitting diodes (LEDs), that project columnar beams of light represented by the beam 228. The illumination source 224 is positioned a sufficient distance above the conveyor 212 so that the parcel 214 may be positioned on the conveyor 212 to pass beneath the moving-light illumination source 224. An operator may therefore view the spot 230, which is defined by light projected by the moving-light illumination source 224, directly on the parcel 214 as the operator positions the parcel 214 on the conveyor 212. The spot 230 thus provides an optical guide to assist the operator in positioning the parcel 214 on the conveyor 212.

A sensor assembly 232, including a height sensor and reflectivity sensor, is located toward the downstream end of the illumination source 224. A communication link 234 functionally connects the sensor assembly 232 to a scanner 236 that is located downstream from the sensor assembly 232. The scanner 236 includes internal components 233 well known to those skilled in the art to automatically focus the scanner 236 in response to height data from the height sensor, and to automatically adjust the gain of the scanner 236 in response to reflectivity data from the reflectivity sensor, so that the scanner 236 generates a clear image of the top of the parcel 214 at the region to be captured and stored for subsequent processing by a character recognition system 240 as the parcel 244 passes beneath the scanner 236. The scanner 236 is aligned with the spot 230 so that the scanner may be operated to capture an image of the destination address 220 on the parcel 214.

A belt encoder 238 measures the displacement of the conveyor 212. A communication link 240 functionally connects the belt encoder 238 to the scanner 236 and to a character recognition system 240 that includes a processing module 241 and a computer memory 242. A second communication link 244 functionally connects the character recognition system 240 to the scanner 236, and a third communication link 246 functionally connects the character recognition system 240 to the moving-light illumination source 224. The signal from the belt encoder 238 is used to determine the speed of the conveyor 212, which is used to synchronize the operation of the moving-light illumination source 224, the scanner 236, and the character recognition system 240 so that an image of a region 250 defined with respect to the spot 230 is

stored in the computer memory 242. The height data from the sensor assembly 232 indicates the presence of a parcel 214 in association with a spot 230 so that an image of a region 250 is only stored in the computer memory 242 when a parcel 214 is present in association with a spot 230 defined by the moving-light illumination source 224.

5 To use the moving-light indicia reader system 200, an operator positions the parcel 214 on the conveyor 212 so that the spot 230 defined by the moving-light illumination source 224 is centered with respect to the destination address 220 on the parcel 214. For example, FIG. 2A illustrates the parcel 214 positioned so that the spot 230 defined by the first discrete illumination source 226a is centered with respect to the destination address 220. From this position, the parcel 214 travels on the conveyor 212, and the spot 230 travels at the same speed as the parcel 214, so that the spot 230 remains stationary relative to the parcel 214. Thus, as illustrated in FIG. 2B, the parcel 214 is later positioned so that the spot 230' defined by the third discrete illumination source 226c is centered with respect to the destination address 220. Later still, as illustrated in FIG. 2C, the parcel 214 is positioned so that the spot 230'' defined by the last discrete illumination source 226n is centered with respect to the destination address 220.

FIGS. 2D and 2E illustrate the scanning of the parcel 214 by the scanner 236, which includes a CCD array that repeatedly generates an image of a scan line 252 to generate a video signal. The operation of the scanner 236 and the processing module 241 of the character recognition system 240 are synchronized with the movement of the spot 230 so as to store in the computer memory 242 an image of the region 250, which is defined with respect to the spot 230. When the region 250 reaches the scan line 252, which happens shortly after the parcel 214 is in the position shown in FIG. 2D, the processing module 241 causes the computer memory 242 of the character recognition system 240 to begin storing the video data generated by the scanner 236. The video data generated by the scanner 236 continues to be stored until the region 250 passes the scan line 252, which happens shortly before the parcel 214 is in the position shown in FIG. 2E.

It will be understood that, when the parcel 214 is positioned as shown in FIGS. 2D-E, the spot 230 is not visible to an operator because the parcel 214 is not under the moving-light illumination source 224. Nevertheless, the character recognition system 240 uses the signal from the belt encoder 238 to keep track of the spot 230 after the parcel 214 travels past the moving-light illumination source 224. Thus, an image of the region 250, which is defined with respect to the spot 230, is stored in the computer memory 242 of the character recognition system 240.

35 FIG. 3 illustrates a parcel 214 with the spot 230 defined by the moving-light illumination source 224. The spot 230 is typically a round or oval area that is somewhat smaller than the region 250 to be imaged by the scanner 236. For example, the area associated with the spot 230 may be approximately one inch (2.5 cm) across, whereas the region 250 may be approximately 4 inches (10 cm) by 4 inches (10 cm). The parcel 214 is

preferably positioned so that the center of the spot 230 is approximately in the center of the city and state address lines of the destination address 220. This allows the scanner 236 to capture an image of the destination address 220 by imaging the region 250.

5 It will be appreciated, however, that the spot 230 may have virtually any size or configuration, and that multiple spots may be used to identify indicia on the parcel, such as four spots defining the corners of a rectangular region to be imaged. For example, the spot 230 may be defined by an illuminated area, or by an illuminated border, or by two illuminated spaced-apart parallel lines, etc. In addition, the spot 230 could be configured to correspond to the width of the region 250 to be stored in the computer memory 224. This would assist an
10 operator in orienting a parcel 214 so that the destination address 220 can be effectively scanned by the indicia reader system 200 as configured. Alternatively, the operator may determine that the parcel 214 cannot be oriented so that the destination address 220 can be effectively scanned by the indicia reader system 200 as configured. This may happen if the destination address 220 is larger than the region 250 to be stored in the computer memory 242. In this case, the
15 operator can divert the parcel 214 for hand sorting or imaging using a differently configured indicia reader system.

To capture the image of the region 250, the character recognition system 240 is operative to selectively trigger the storage of an image in the computer memory 242. Triggering the storage of the image of the region 250 in the computer memory 242 may be accomplished in
20 several different ways. For example, the scanner 236 may be toggled on and off by the processing module 241 in response to the signal from the belt encoder 238. Or the scanner 236 may run continuously, and the processing module 241 may respond to the signal from the belt encoder 238 by latching a control line to an input buffer of the character recognition system 240. Alternatively, the signal from the belt encoder 238 may be used as an input to a software-
25 based algorithm running on the processing module 241, which triggers the storage of video data from the scanner 236 in the computer memory 242. Many other means known to those skilled in the art may equivalently be employed to operate the character recognition system 240 and the scanner 236 so as to store an image of the region 250 in the computer memory 242.

Acceptable performance is experienced when moving-light indicia reader system 200 is
30 configured as follows. The belt encoder 238 is a standard belt-driven, opto-mechanical encoder that provides a signal indicating the linear displacement of the conveyor 212. The CCD array of the scanner 236 is cycled in response to the signal from the belt encoder 238 to generate a series of analog images of the scan line 252 that are transmitted to an analog-to-digital converter within the scanner 236. The analog-to-digital converter of the scanner 236 uses a standard
35 thresholding or similar process to convert the analog signal produced by the CCD array of the scanner 236 into an eight-bit digital video signal that is transmitted via the communication link 246 to the character recognition system 240, which is operable for storing the video data in the computer memory 242 for subsequent processing.

The scanner 236 is preferably a monochrome, 4,096 pixel line-scan type CCD array

such as one using a Thompson TH7833A CCD chip. As the field of view of the scanner 236 is approximately 16 inches (41 cm) at the conveyor 212, the resolution of the image created by the scanner 232 is approximately 256 pixels or "dots" per inch (DPI) (101 dots per cm) across the field of view of the scanner 236. The belt encoder 238 preferably triggers the CCD array of the scanner 236 at a rate of approximately 256 cycles per inch (2.54 cm) so that the resolution of the image created by the scanner 232 is approximately 256 pixels or "dots" per inch (DPI) (101 dots per cm) in the direction of conveyor travel. It will therefore be appreciated that a digital image with a correct aspect ratio (i.e., the ratio of the length of the image to the width) may be generated by the scanner 236 and stored in the computer memory 242 of the character recognition system 240 by synchronizing the cycling rate of the scanner 236 with the linear speed of the conveyor 212.

The conveyor 212 may be approximately 24 inches (61 cm) wide and travel at linear speeds up to 20 inches per second or 100 feet per minute (51 cm per second or 30 meters per minute) or more. The moving-light illumination source 224 is preferably positioned approximately 18 inches (46 cm) above conveyor 212 and defines a spot 230 that is approximately 1 inch (2.5 cm) wide and 1 inch (2.5 cm) long at the conveyor 212. The moving-light illumination source 224 may be operated so that successive moving spots 230 are spaced virtually any distance apart. For example, acceptable performance is experienced when the moving-light indicia reader system 200 is operated with the conveyor 212 traveling at 50 feet per minute (25 cm per second or 15 meters per minute), and with the moving spots 230 spaced 22 inches (56 cm) apart, which allows the moving-light indicia reader system 200 to handle approximately 1,636 parcels per hour if the operator places a parcel under each moving spot.

The scanner 236 is preferably mounted to have an optical path of approximately 120 inches (305 cm) to the conveyor 212, with a 16 inch (41 cm) field of view at the conveyor 212. To save space, the scanner 236 is positioned approximately 30 inches (76 cm) above the center of conveyor 212 and is pointed towards a complex of mirrors (not shown) that increases the optical path from the scanner 236 to the conveyor 212 to approximately 120 inches (305 cm). These parameters may be varied somewhat without unduly affecting the performance of the disclosed embodiment of the present invention.

It should also be understood that the scan line 234 may be longer than the width of the region stored in the computer memory 242. For example, the scanner 232 may be positioned to have a field of view (i.e., the scan line 234) equal to approximately 16 inches (41 cm) at the conveyor 212. The region stored in the computer memory 242, however, may only be approximately 4 inches (10 cm) wide. This may be accomplished by only storing the output of a portion of the cells of the scanner 232 (e.g., the center 1,024 pixels of a 4,096 pixel scanner) in the computer memory 242.

It will be appreciated that the moving-light illumination source 224 should be long enough to allow an operator to position the parcel 214 on the conveyor 212 while the spot 230

travels from the upstream end to the downstream end of the moving-light illumination source 224. For example, a moving-light illumination source 224 having a length of 36 inches (91 cm) and 72 LEDs spaced 1/2 inch (1.3 cm) apart is appropriate for the conveyor 212 traveling at 10 inches per second or 50 feet per minute (25 cm per second or 15 meters per minute), as described above. The LEDs 226a-n of the moving-light illumination source 224 may be any of a variety of commercially available LEDs, such as a model AND190W0P manufactured by AND. The sensor assembly 232 may include any of a variety of commercially available height sensors, such as a model NR-40 manufactured by Innova Labs, Inc.

FIG. 4 is a diagram of a multi-conveyor indicia reader system 400 that includes a plurality of moving-light indicia reader systems 210a through 210n, which are virtually identical to those described above with respect to FIGS. 2A-E. Each of the moving-light indicia reader systems 210a through 210n are synchronized by, and provide their video data to, a single character recognition system 240. The character recognition system 240 synchronizes the moving spots 230a through 230n of the moving-light indicia reader systems 210a through 210n so as to time-division multiplex the storage of the regions 250a through 250n from the several scanners 236a through 236n. In other words, the spots 230a through 230n are spaced relative to each other so that only one of the regions 250a through 250n captured by the scanners 236a through 236n needs to be stored in the computer memory 242 of the character recognition system 240 at any time. This allows the single character recognition system 240 to store the images generated by several moving-light indicia reader systems 210a through 210n, as shown in FIG. 4.

In view of the forgoing, it will be appreciated that the moving-light indicia reader system 400 allows the video data stored in the computer memory 242 of the character recognition system 240 to be reduced to a standard-sized region that is only large enough to capture the text of the destination addresses 220a-220n on the various parcels carried on the conveyors 212a-212n. The use of projected illumination allows the operator to view the spot 230a-230n defined by each moving-light illumination source 224a-224n directly on the top of the parcels 214a-214n. Thus, there is no displacement between each spot 230a-230n and the top of each parcel 214a-214n that could cause parallax-related alignment errors with tall parcels. In addition, the moving-light indicia reader system 400 allows the angle of the field of view of the scanners 236a-236n to be relatively narrow so that the scanners generates sharp images of the top of the parcels 214a-214n.

It should be understood that the foregoing relates only to specific embodiments of the present invention, and that numerous changes may be made therein without departing from the spirit and scope of the invention as defined by the following claims.

CLAIMS

What is claimed is:

1. An optically-guided indicia reader system (10, 200) comprising a conveyor (12, 212) for transporting a parcel (14, 214) from an upstream location (16, 216) of the conveyor to a downstream location (18, 218) of the conveyor CHARACTERISED BY;

an illumination source (24, 224) positioned to define an area (26, 230) to assist in positioning the parcel (14, 214) on the conveyor (12, 212);

a scanner (32, 236) located downstream of the illumination source (24, 224);

a computer memory (42, 242) for storing the image; and

means (41, 241) for operating the scanner (32, 236) and the computer memory (42, 242) so as to capture an image of a region (250) defined with respect to the area (26, 230).

2. The optically-guided indicia reader system (10, 200) of Claim 1, further comprising:

a height sensor (28, 232) located upstream of the scanner (32, 236) and positioned to determine height data associated with the parcel (14, 212);

a communication link (30, 234) for transmitting the height data from the height sensor (28, 232) to the scanner (32, 236); and

means (33, 233) for focusing the scanner (32, 236) in response to the height data.

3. The optically-guided indicia reader system (10, 200) of Claim 1, further comprising:

a reflectivity sensor (28, 232) located upstream of the scanner (32, 236) and positioned to determine reflectivity data associated with the parcel (14, 214);

a communication link (30, 234) for transmitting the reflectivity data from the reflectivity sensor (28, 232) to the scanner (32, 236); and

means (33, 233) for adjusting the gain of the scanner (32, 236) in response to the reflectivity data.

4. The optically-guided indicia reader system (10) of Claim 1, wherein:
the area comprises a static elongate strip (26) having a width that is narrower than the conveyor (14); and

the region has a width approximately equal to the width of the static elongate strip (26).

5. The optically-guided indicia reader system (10) of Claim 1, further comprising:
means (41, 241) for operating the computer memory (42) and the scanner (32) so as to store an image of a region having a width approximately equal to the width of the area (26).

6. The optically-guided indicia reader system (10) of Claim 1, further comprising:
a proximity sensor (46) for detecting the presence of the parcel (14) at a predefined position (50) along the conveyor (12); and

5 a communication link (48) between the proximity sensor (46) and the scanner (32); and
means (36, 41) for, in response to the proximity data, operating the computer memory (42) and the scanner (32) so as to store an image of a region having a width approximately equal to the width of the area (26) and a length approximately equal to the length of the parcel (14) in the direction of conveyor travel.

10 7. The optically-guided indicia reader system (200) of Claim 6, wherein:
the area comprises a spot (230) that moves at the same speed as the conveyor (212) to assist in positioning the parcel (214) on the conveyor (212).

15 8. The optically-guided indicia reader system (200) of Claim 6, wherein the spot (230) is significantly smaller than the region (250).

9. A multi-conveyor indicia reader system (400) comprising a plurality of a conveyors (212), each for transporting parcels (214) from an upstream location (216) of the conveyor to a downstream location (216) of the conveyor CHARACTERISED BY:

5 a plurality of moving-light indicia reader systems (210), wherein each moving-light indicia reader system comprises,

an illumination source (224) for defining a spot (230) that moves at the same speed as the conveyor (212) to assist in positioning the parcel (214) on the conveyor (212), and

a scanner (236) located downstream of the illumination source (224) and positioned to capture an image of the parcel (214);

10 a computer memory (242) for storing the images; and

means (241) for operating the computer memory (214) and the scanner (236) of each moving-light indicia reader system (210a - 210n) and so as to store an image of a region (250) of the parcel (214) defined with respect to the spot (230) defined by the illumination source.

15 10. The multi-conveyor indicia reader system of Claim 9, wherein the illumination sources (224a - 224n) are operated so as to time-division multiplex the storage of the images generated by the plurality of moving-light indicia reader systems (210a - 210n).

20 11. The multi-conveyor indicia reader system of Claim 9, wherein each moving-light indicia reader system (210) further comprises:

a height sensor (232) located upstream of the scanner (236) and positioned to determine height data associated with the parcel (214) at the location of the spot (230);

a communication link (234) for transmitting the height data from the height sensor (232) to the scanner (236); and

25 means (233) for focusing the scanner (236) in response to the height data.

12. The multi-conveyor indicia reader system (400) of Claim 10, wherein each moving-light indicia reader system (210) further comprises:

30 a reflectivity sensor (232) located upstream of the scanner (236) and positioned to determine reflectivity data associated with the parcel (214) at the location of the spot (230);

a communication link (234) for transmitting the reflectivity data from the reflectivity sensor (232) to the scanner (236); and

means (233) for adjusting the gain of the scanner (236) in response to the reflectivity data.

13. A method for obtaining an image of indicia on a parcel (14, 214), comprising the step of providing a conveyor (12, 212) for transporting a parcel from an upstream location (16, 216) of the conveyor to a downstream location (18, 218) of the conveyor (12, 212), CHARACTERISED BY THE STEPS OF;

5 providing an illumination source (24, 224) positioned to define an area (26, 230) to assist in positioning the parcel (14, 214) on the conveyor (12, 212);

positioning the parcel (14, 214) so that the indicia (20, 220) is within the area (26, 230) defined by the illumination source (24, 224);

10 operating a scanner (32, 236) to capture an image of a region (250) defined with respect to the area (26, 230) to obtain an image of the indicia (20, 220); and
storing the image in a computer memory (42, 242).

14. The method of Claim 13, further comprising the steps of:
generating height data associated with the parcel (14, 214); and
15 focusing the scanner (32, 236) in response to the height data.

15. The method of Claim 13, further comprising the steps of:
generating reflectivity data associated with the parcel (14, 214); and
adjusting the gain of the scanner (32, 236) in response to the reflectivity data.

20 16. The method of Claim 13, wherein:
the area comprises an elongate strip (26) having a width that is narrower than the conveyor (12); and

25 the region has a width approximately equal to the width of the elongate strip (26).

17. The method of Claim 13, further comprising the steps of:
operating a computer memory (42) and the scanner (32) so as to store an image of a region having a width approximately equal to the width of the area (26).

30 18. The method of Claim 13, further comprising the steps of:
generating proximity data associated with the parcel (14); and
in response to the proximity data, operating a computer memory (42) and the scanner (32) so as to store an image of a region having a width approximately equal to the width of the area (26) and a length approximately equal to the length of the parcel (14) in the direction of
35 conveyor travel.

19. The method of Claim 13, wherein :
the step of illuminating the area to assist in positioning the parcel (214) on the conveyor (212) comprises the step of illuminating a spot (230) that moves at the same speed as the
40 conveyor (212).

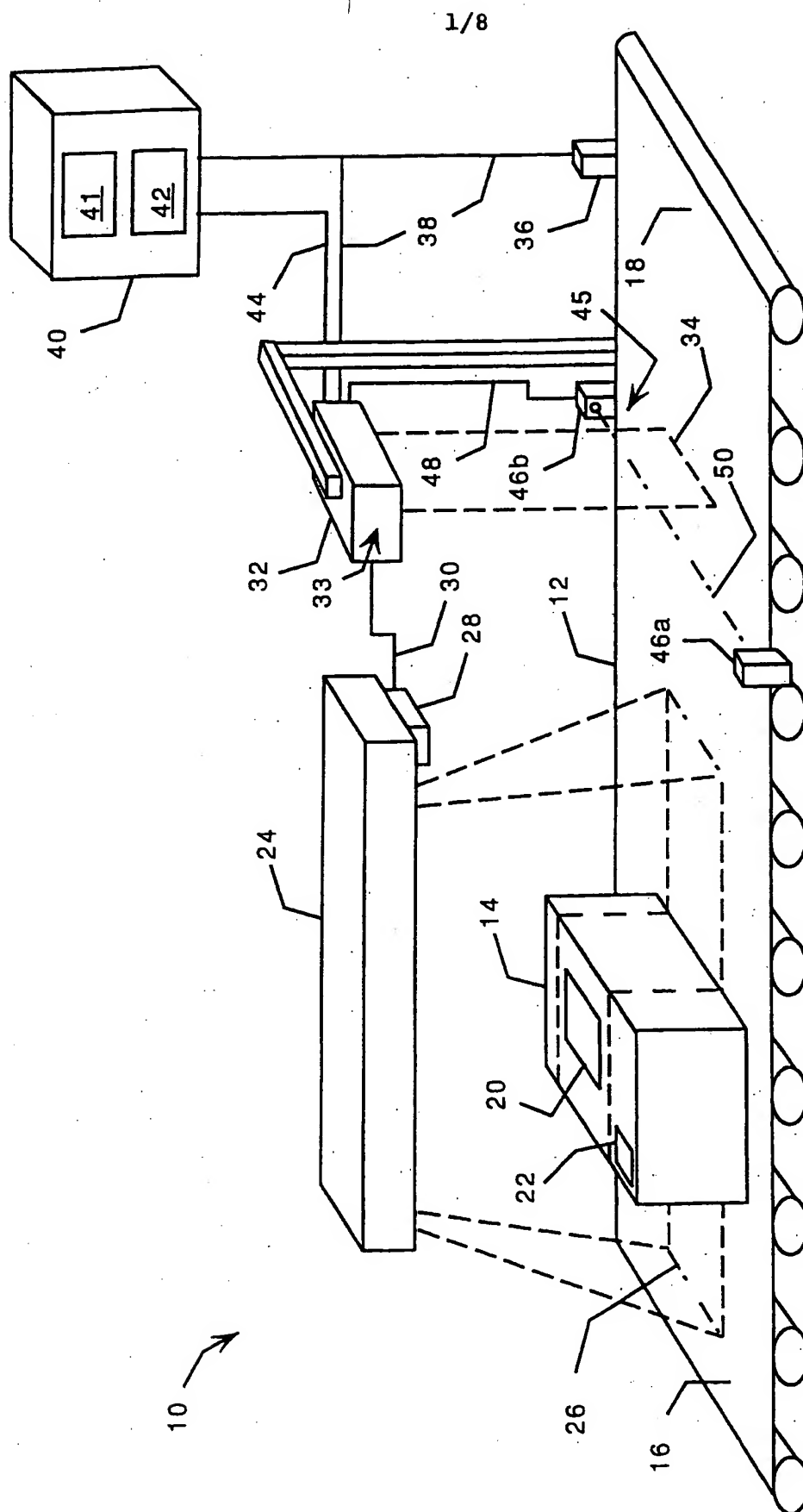


FIG. 1

2/8

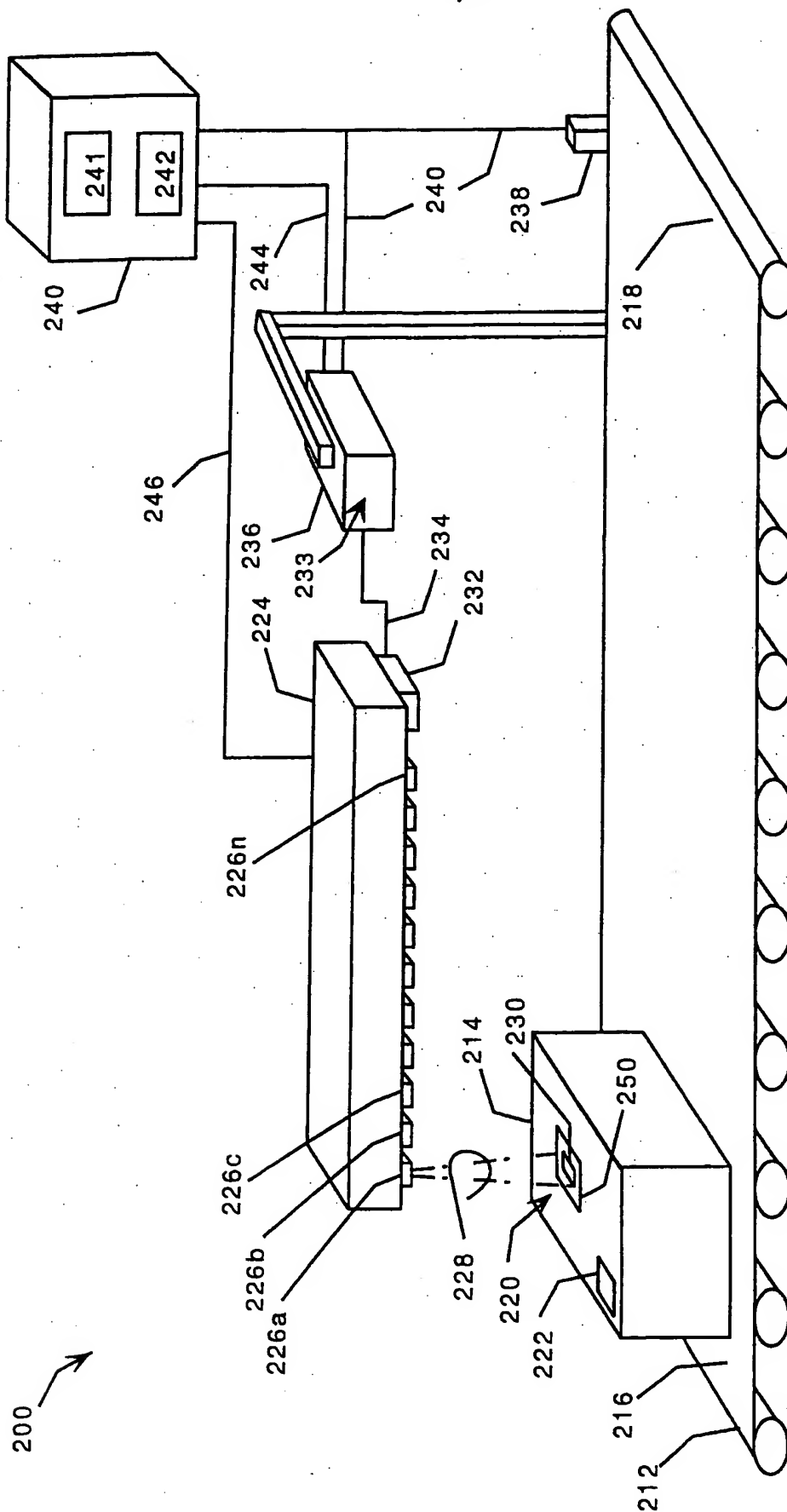


FIG. 2A

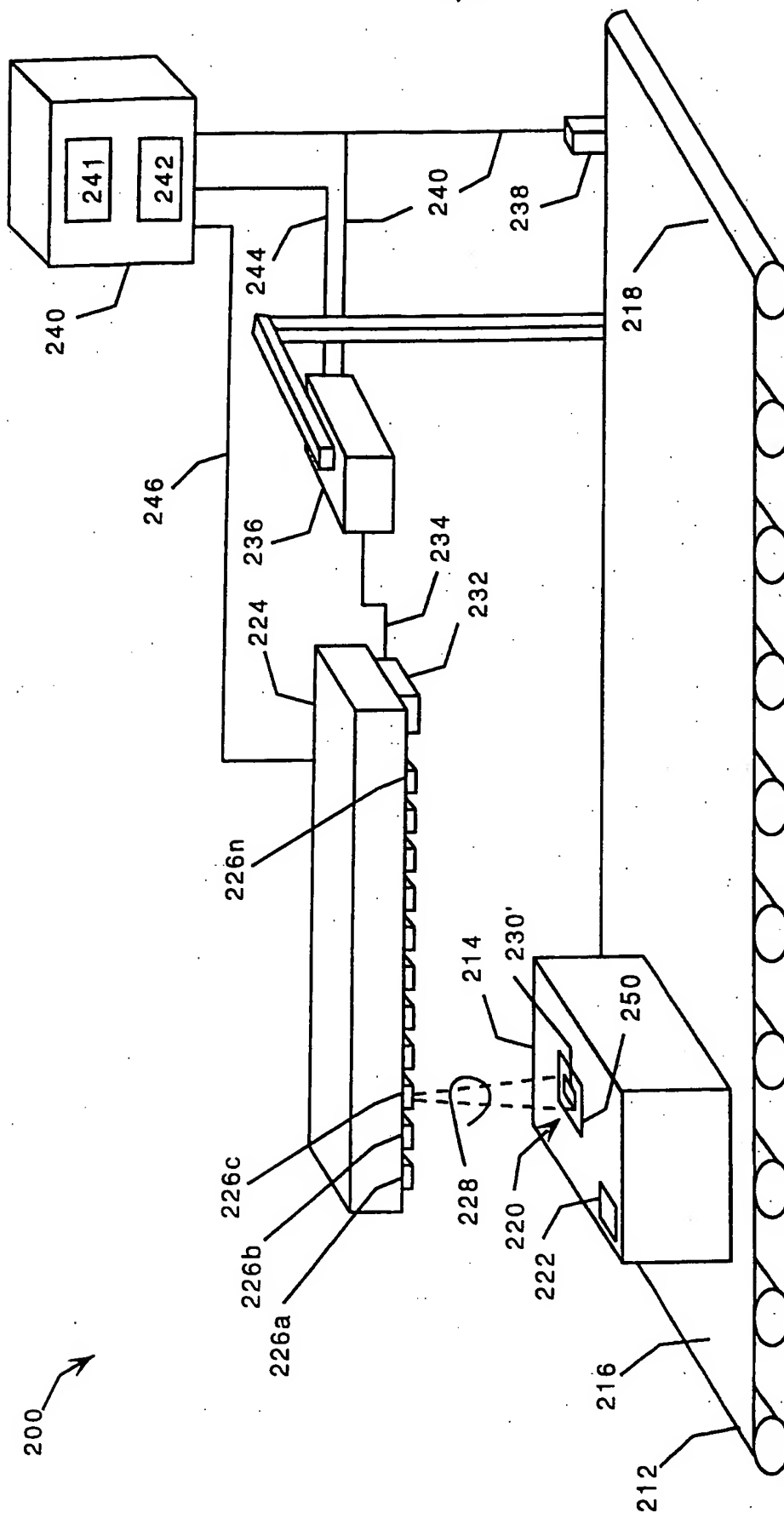


FIG. 2B

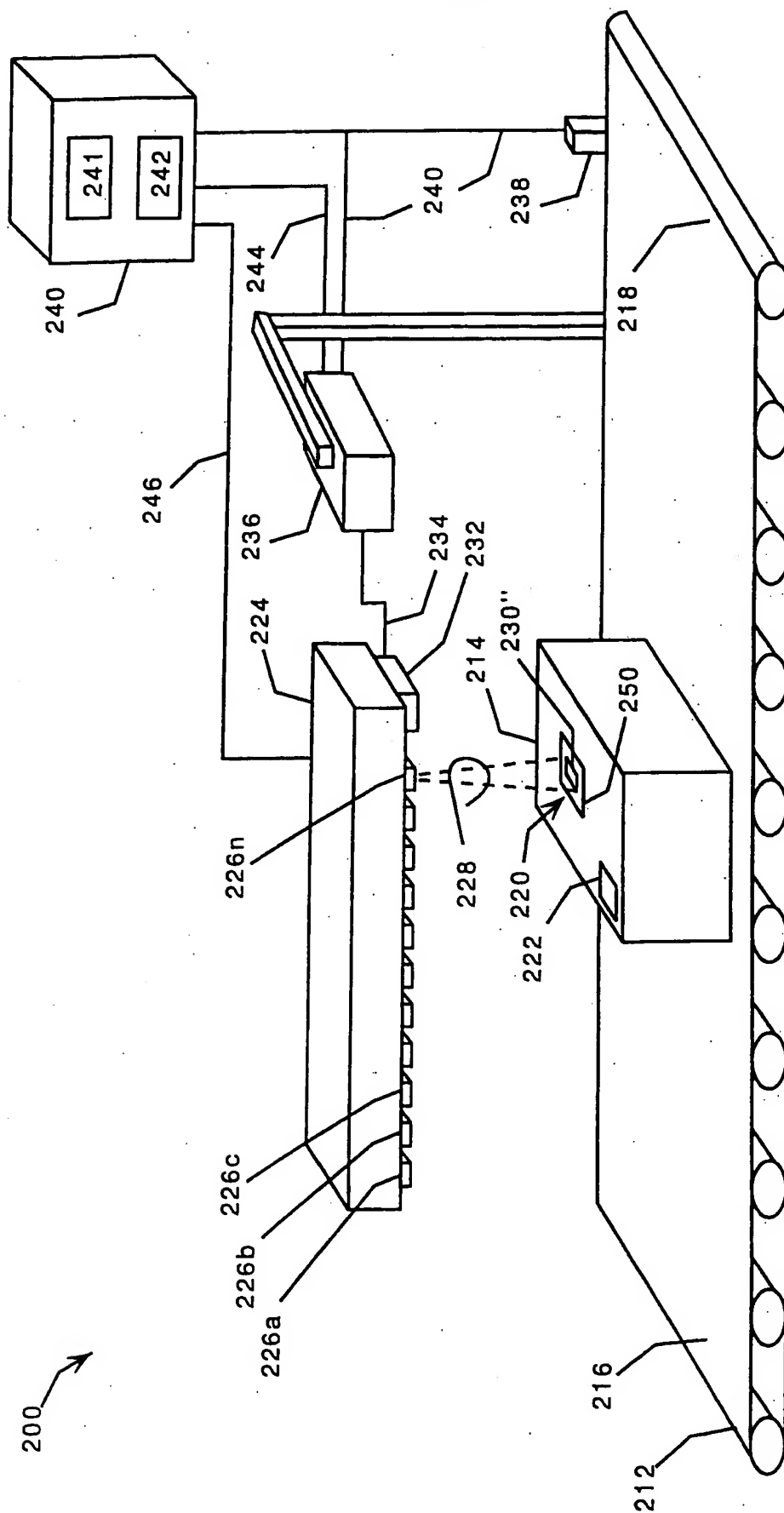


FIG. 2C

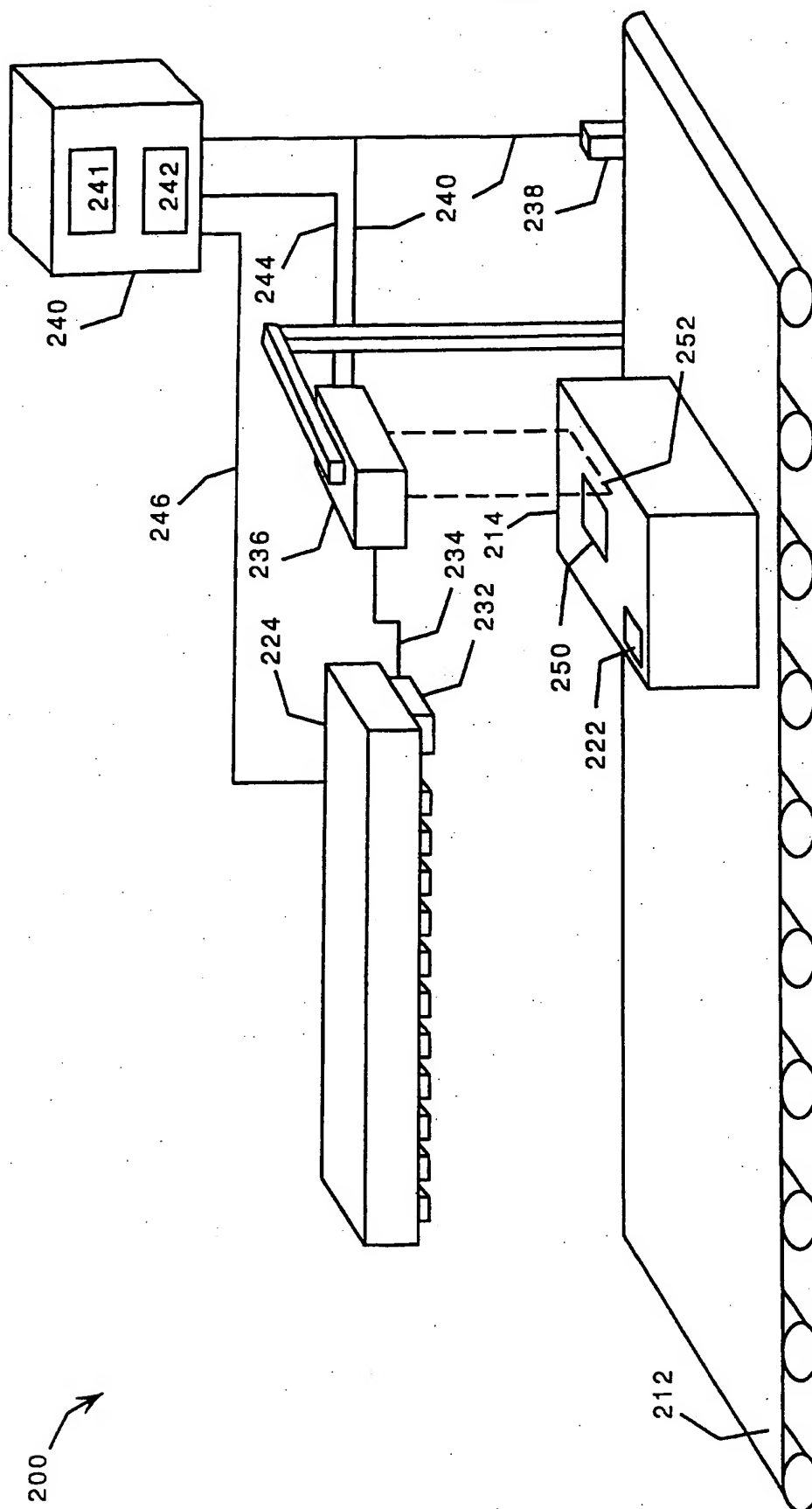


FIG. 2D

6/8

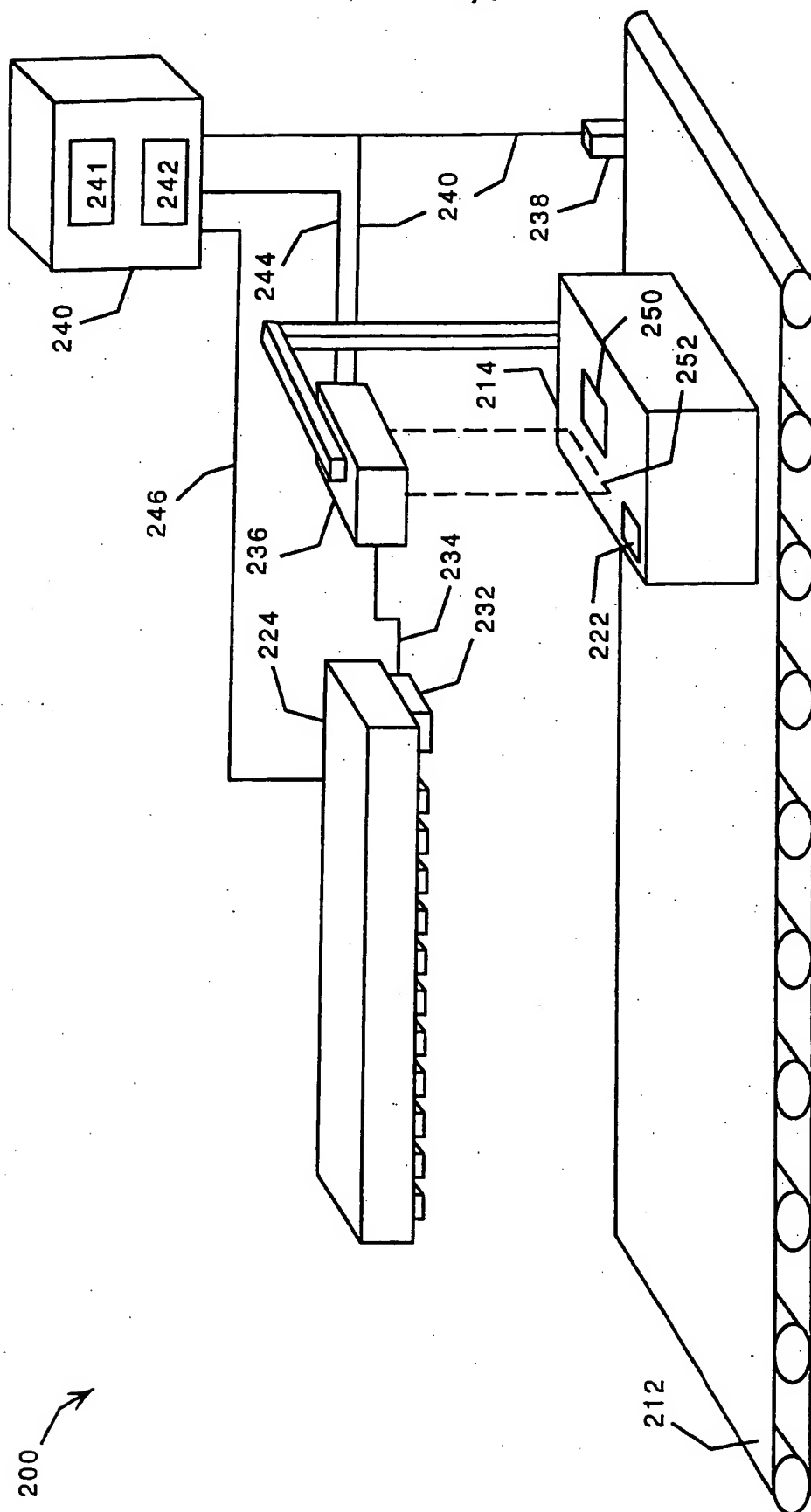


FIG. 2E

7/8

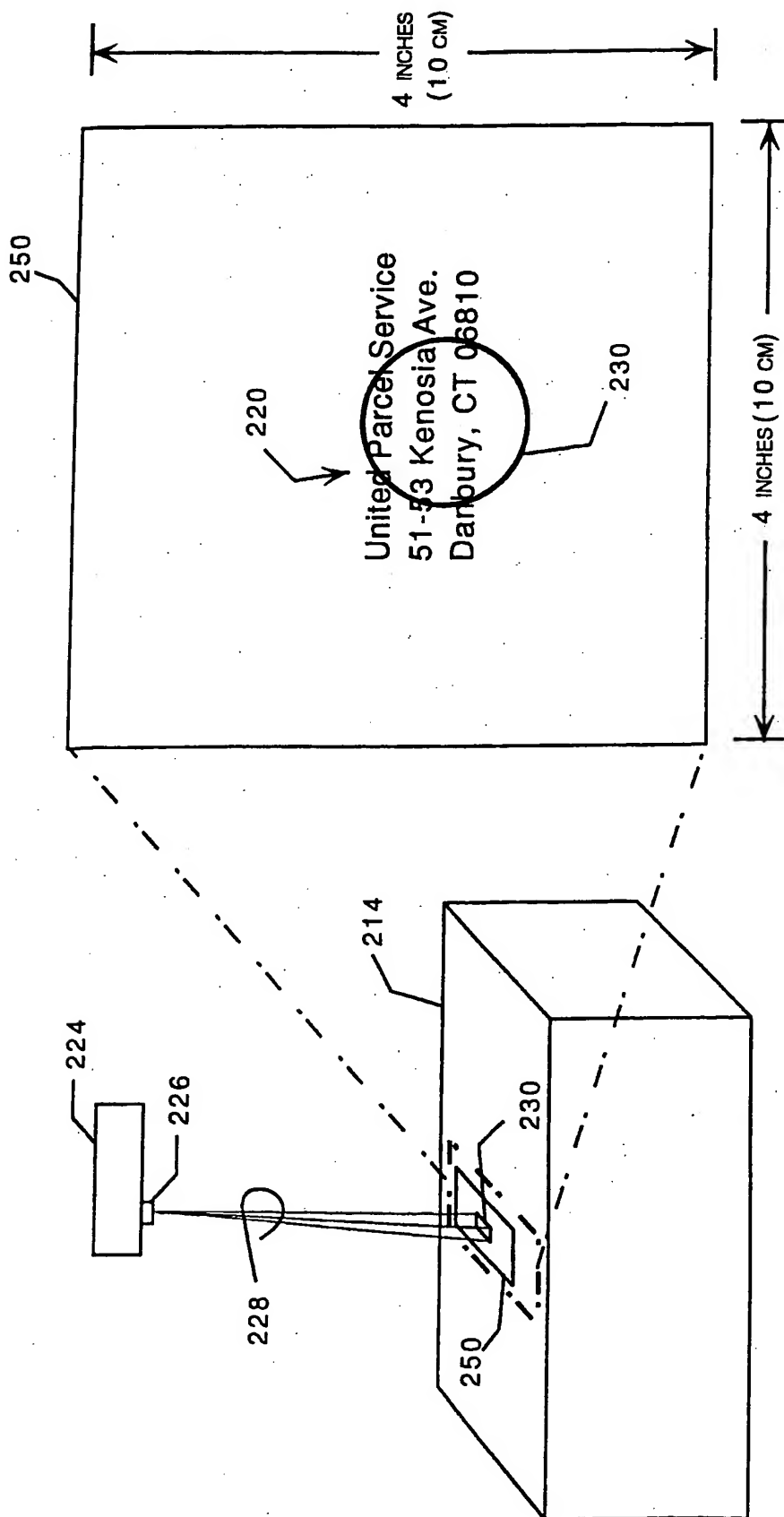


FIG. 3

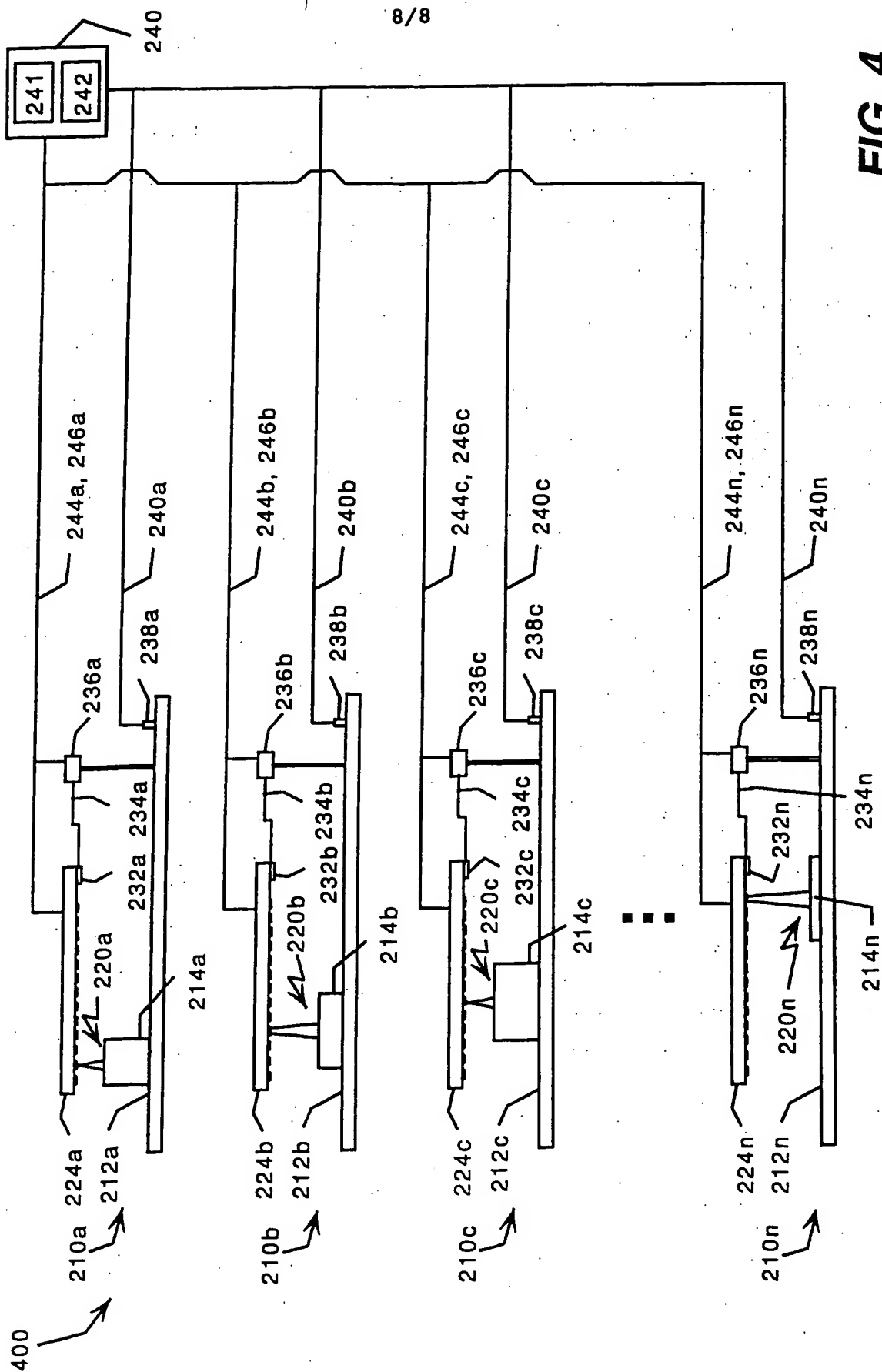


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/01366

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B07C3/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B07C G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"parcel positioning scanning and sorting system" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 15, no. 4, September 1972, US, pages 1170-1171, XP002065579	1,2,5-8, 11,13, 14,17-19
A	see the whole document	4,9,16
A	EP 0 647 479 A (GALAI LABORATORIES) 12 April 1995	1,2,5,6, 11,13, 14,17,18
	see the whole document	
A	EP 0 440 129 A (COMPAGNIE GENERALE D'AUTOMATISME) 7 August 1991	
A	US 5 202 557 A (ROBERTSON) 13 April 1993	
A	GB 1 270 801 A (EMI) 19 April 1972	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

20 May 1998

Date of mailing of the international search report

03/06/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Forlen, G

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 98/01366

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 647479	A	12-04-1995	NONE	
EP 440129	A	07-08-1991	FR 2657982 A	09-08-1991
			CA 2035555 A	03-08-1991
			DE 69110912 D	10-08-1995
			DE 69110912 T	16-11-1995
			US 5103489 A	07-04-1992
US 5202557	A	13-04-1993	EP 0565215 A	13-10-1993
			EP 0764476 A	26-03-1997
			JP 6208643 A	26-07-1994
			US 5451771 A	19-09-1995
			US 5371357 A	06-12-1994
GB 1270801	A	19-04-1972	NONE	